PB-245 804

# A BENTHIC SURVEY OF FLAT CREEK AND THE SALT RIVER NEAR THAYNE, WYOMING

Environmental Protection Agency
Denver, Colorado

February 1973

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PB 245 804

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US Department of Commerce
Springfield, VA. 22151

| BIBLIOGRAPHIC DATA SHEET | 1. Report No. | 2. | 3. Recipient's Accession No. |
|---|---|---|---|
| 4. Title and Subtitle A Bethnic Survey of Flat Creek and the Salt River Near Thayne, Wyoming | | | 5. Report Date Nov. 1972<br>6. |
| 7. Author(s) | | | 8. Performing Organization Rept. No. |
| 9. Performing Organization Name and Address<br>Environmental Protection Agency<br>Region VIII<br>Denver Colorado | | | 10. Project/Task/Work Unit No.<br>11. Contract/Grant No. |
| 12. Sponsoring Organization Name and Address<br>Environmental Protection Agency<br>Region VIII<br>Denver, Colorado | | | 13. Type of Report & Period Covered<br>14. |

15. Supplementary Notes

16. Abstracts A bethnic survey was conducted to determine possible effects on Flat Creek and the Salt River of whey and raw sewage discharged from the Star Valley Dairy. The effluent of whey & sewage from the dairy & associated restaurants is discharged directly into Flat Creek. Approximately two miles downstream from the effluent discharge, Flat Creek flows into the Salt River.

17. Key Words and Document Analysis. 17a. Descriptors

* Sewage
* Effluents

17b. Identifiers/Open-Ended Terms

* Whey
* Bethnic survey
Flat Creek
Salt River

17c. COSATI Field Group

PRICES SUBJECT TO CHANGE

| 18. Availability Statement | 19. Security Class (This Report) | 21. No. of Pages |
|---|---|---|
| Release Unlimited | UNCLASSIFIED | 16 |
| | 20. Security Class (This Page) UNCLASSIFIED | 22. Price 3.25 |

SA/TSB-14

# A BENTHIC SURVEY OF FLAT CREEK AND THE SALT RIVER NEAR THAYNE, WYOMING

TECHNICAL SUPPORT BRANCH
SURVEILLANCE AND ANALYSIS DIVISION

U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII

November 1972

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## INTRODUCTION

On August 29-30, 1972, at the request of the Enforcement Division of Region VIII, a benthic survey was conducted on Flat Creek and the Salt River near Thayne, Wyoming, by Ronald M. Eddy, a biologist from the Surveillance and Analysis Division, and Thomas Willingham from the Permits Branch. The survey was conducted to determine possible effects on Flat Creek and the Salt River of whey and raw sewage discharged from the Star Valley Dairy. The effluent of whey and sewage from the dairy and associated restaurant is discharged directly into Flat Creek. Approximately two miles downstream from the effluent discharge, Flat Creek flows into the Salt River (Figure 1).

## METHODS AND MATERIALS

All quantitative samples were collected with a square-foot Surber sampler. Qualitative samples were collected both by removing organisms from selected rocks and debris by hand and with the use of a large dip net. All samples were preserved in 10% Formalin and transported to the Region VIII Biology Laboratory in Denver, Colorado, for processing.

Figure 1 shows the location of each sampling station on Flat Creek and the Salt River. A description of the physical characteristics of each station is given in Table 1.

## RESULTS AND DISCUSSION

The results of the Flat Creek benthic survey are shown in Table 2. All organisms were classified to the lowest taxinomic level possible.

Two Surber samples were taken at all stations except FC-$D_1$-1 and FC-$D_1$-2. The quantity of organisms collected from the Surber samples taken at each station was averaged for each station and the values recorded in Table 2.

For the purpose of this discussion, organisms will be classified according to their sensitivity to organic pollution as pollution sensitive, pollution intermediate, and pollution tolerant. Pollution sensitive organisms are those which cannot withstand major reductions of dissolved oxygen or the smothering effect of sludge deposits often associated with organic pollution. With a moderate reduction of the dissolved oxygen concentration, the number and kinds of pollution sensitive organisms decrease with an associated increase in pollution intermediate and pollution tolerant organisms. With still further reductions of dissolved oxygen, the pollution intermediate organisms decrease with pollution tolerant organisms becoming predominant.

Of the major organisms collected from Flat Creek, *Ephemeroptera* (mayflies), *Tricoptera* (caddis flies), and *Plecoptera* (stoneflies) are examples of pollution sensitive organisms, while *Simulidae* (blackflies) and *Chironomidae* (midges) are examples of pollution intermediate forms.

FIGURE 1

Sampling Station Locations on Flat Creek and the Salt River near Thayne, Wyoming

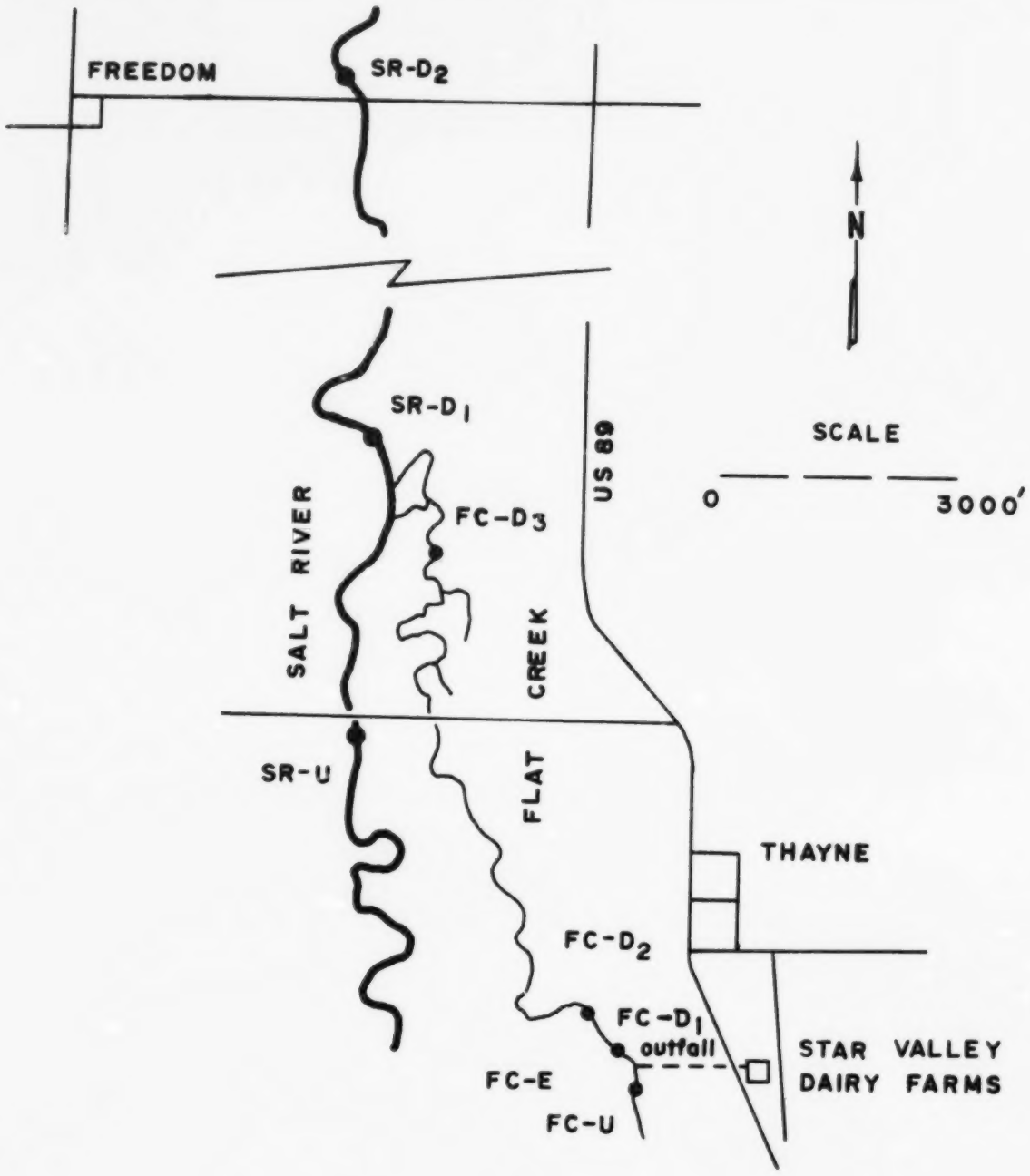

TABLE 1

Sampling Station Descriptions for
Flat Creek and the Salt River, Thayne, Wyoming

| Station | Location[1/] | Bottom Type | Stream Width | Physical Characteristics |
|---|---|---|---|---|
| FC-U | Flat Creek - 20 yards upstream of effluent. | 75% rock<br>25% gravel | 20 ft. | Bottom completely covered with excessive growths of algae and aquatic plants. |
| FC-Q | Same as above - qualitative sample. | | | |
| FC-E | Star Valley Dairy effluent taken directly from the weir box prior to discharge into Flat Creek. | | | |
| $FC-D_1-1$ | Flat Creek - 20 yards downstream of effluent discharge, effluent side of stream. | 75% rock<br>25% gravel | 20 ft. | Bottom, algae, and aquatic plants covered with thick layer of congealed whey. |
| $FC-D_1-2$ | Same as above - opposite side of stream. | | | No deposits of congealed whey--little or no lateral mixing of the effluent. |
| $FC-D_2$ | Flat Creek - 300 yards downstream of effluent. | 75% rock<br>25% gravel | 20 ft. | Large masses of congealed whey trapped in algae and aquatic plants: bottom not completely covered. |
| $FC-D_3$ | Flat Creek - 2 miles downstream of effluent - 200 yards above confluence with Salt River. | 50% rock<br>50% gravel | 25 ft. | Reduction of algal growths although still abundant. |
| SR-U | Salt River - 1/2 mile above confluence of Salt River and Flat Creek. | 60% rock<br>40% gravel | 30 ft. | No large growths of algae present. |
| $SR-D_1$ | Salt River - 20 yards below confluence with Flat Creek. | 50% rock<br>50% gravel | 40 ft. | |
| $SR-D_2$ | Salt River - 3 miles below confluence with Flat Creek. | 50% rock<br>50% gravel | 40 ft. | Both Surber samples taken on the edge of a small island in the middle of Salt River. |

1/ All samples were collected in shallow riffle areas. Two Surber samples were collected at each station, except $FC-D_1-1$ and $FC-D_1-2$.

TABLE 2

Average Number of Benthic Organisms
Collected from Flat Creek, near Thayne, Wyoming

| Benthic Organisms | FC-U | FC-Q[1/] | FC-$D_1$-1 | FC-$D_1$-2 | FC-$D_2$ | FC-$D_3$ |
|---|---|---|---|---|---|---|
| *Ephemeroptera* | | | | | | |
| *Baetis sp.* | 78 | Q | 1 | 104 | 478 | 133 |
| *Ephemerella sp.* | 2 | Q | - | 11 | 2 | 1 |
| *Paraleptophlebia sp.* | - | Q | - | - | - | - |
| *Heptagenia sp.* | - | Q | - | - | - | - |
| *Tricoptera* | | | | | | |
| *Agapetus sp.* | 3 | Q | - | - | 1 | - |
| *Hydropsyche sp.* | 1 | - | - | - | - | - |
| *Plecoptera* | | | | | | |
| *Nemoura sp.* | 2 | Q | 1 | - | - | - |
| *Hemiptera* | | | | | | |
| *Corixidae* | - | - | - | - | - | - |
| *Coleoptera* | | | | | | |
| *Elmidae* | 14 | Q | - | 72 | 1 | 2 |
| *Diptera* | | | | | | |
| *Simulidae* | 33 | Q | - | 49 | 138 | 118 |
| *Chironomidae* | 105 | Q | 5 | 67 | 546 | 1221 |
| *Empididae* | 3 | Q | - | - | - | 2 |
| *Tipulidae* | 2 | Q | - | - | - | 1 |
| *Rhagionidae* | - | - | - | 1 | - | - |
| *Tabanidae* | - | - | - | 1 | - | - |
| *Oligochaetes* | 56 | Q | 1 | 75 | 57 | 6 |
| *Annelida* | | | | | | |
| *Hirudinea* | 56 | Q | - | 39 | 16 | 2 |
| Total Number of Kinds . . . | 12 | 13 | 4 | 9 | 7 | 9 |
| Total Number per sq. ft.. . | 355 | - | 8 | 419 | 1239 | 1486 |

1/ Qualitative sample - not used for computation of number of organisms per sq. ft.

Fourteen different kinds of organisms were collected from the upstream control station (FC-U). Of the organisms collected, pollution sensitive mayflies (*Baetis sp.*) were the most prevalent, averaging 78 organisms per sq. ft. Although pollution sensitive caddis flies and stoneflies were collected, the small number taken indicate a minor role in the benthic population. Blackflies and midges averaged 33 and 105 organisms per sq. ft., respectively.

The first downstream station ($FC\text{-}D_1\text{-}1$) illustrates the detrimental effect of the whey effluent on the benthic community. The first Surber sample ($FC\text{-}D_1\text{-}1$) was taken on the same side of the stream as the effluent discharge. The bottom was covered with a thick layer of congealed whey for approximately 50 yards downstream from the discharge. The large reduction of all kinds of organisms is likely the result of the smothering effect of the whey rather than any toxic quality.

Lateral mixing of the whey had not been affected at the first downstream station. Consequently, the Surber sample taken from the side of the stream opposite the discharge (FC-D-2) did not show any detrimental effect of the whey.

At the second downstream station ($FC\text{-}D_2$), 300 yards downstream of the discharge, large increases in the average number of mayflies, blackflies and midges were observed. Mayflies (*Baetis sp.*) increased from an average of 78 organisms per sq. ft. at the upstream control station to 478 organisms per sq. ft. Blackflies and midges increased from 33 and 105 organisms per sq. ft. at the control station to 133 and 546 organisms per sq. ft., respectively. The large increase in organisms was due to the enriching effect of the sewage portion of the effluent as evidenced by substantial increases in organic carbon, total nitrogen, and phosphorus levels downstream of the effluent (Tables 3, 4, and 5). The enriching effect of the effluent, however, cannot be classified as detrimental since not only the midges were increased but also the mayflies, a major fish food organism.

At the last station sampled on Flat Creek ($FC\text{-}D_3$), approximately two miles downstream of the discharge, the quantity of mayflies, blackflies, and midges was significantly higher than the upstream control station (FC-U). Mayflies (*Baetis sp.*) averaged 133 organisms per sq. ft. as compared to 78 organisms per sq. ft. at the control station. Blackflies and midges averaged 118 and 1221 organisms per sq. ft. as compared to 33 and 105 organisms per sq. ft., respectively, at the control station. Although all of the above organisms exhibited increases from the respective control station samples, only the midges experienced an increase in organisms per sq. ft. from the previous sampling station ($FC\text{-}D_2$). The decrease in mayflies and blackflies from the previous station indicates a lessening of the enrichment effect of the effluent due to dilution (Tables 3, 4, and 5).

TABLE 3

Total Organic Carbon Levels at Flat Creek Sampling Stations

| Station | Date | Total Organic Carbon (mg/l) | Average Total Organic Carbon (mg/l) |
|---|---|---|---|
| FC-U | 8/28/72 | 4.0 | < 2.3 |
| | 8/29/72 | < 1.0 | |
| | 8/30/72 | 1.0 | |
| | 8/31/72 | 4.0 | |
| | 9/01/72 | < 1.0 | |
| | 9/02/72 | 3.0 | |
| FC-E | 8/28/72 | 220 | 3472 |
| | 8/29/72 | 7170 | |
| | 8/30/72 | 4670 | |
| | 8/31/72 | 3680 | |
| | 9/01/72 | 119 | |
| | 9/02/72 | 4970 | |
| $FC-D_1-1$ | | No samples taken | |
| FC-D -2 | | No samples taken | |
| $FC-D_2$ | 8/28/72 | 21 | 79 |
| | 8/29/72 | 67 | |
| | 8/30/72 | 135 | |
| | 8/31/72 | 129 | |
| | 9/01/72 | 1 | |
| | 9/02/72 | 121 | |
| $FC-D_3$ | 8/28/72 | 19 | 14 |
| | 8/29/72 | 15 | |
| | 8/30/72 | 7 | |
| | 8/31/72 | 18 | |
| | 9/01/72 | 13 | |
| | 9/02/72 | 12 | |

TABLE 4

Total Phosphorus Levels at Flat Creek Sampling Stations

| Station | Date | Total Phosphorus (mg/l) | Average Total Phosphorus (mg/l) |
|---|---|---|---|
| FC-U | 8/28/72 | 0.05 | 0.045 |
| | 8/29/72 | 0.07 | |
| | 8/30/72 | 0.05 | |
| | 8/31/72 | 0.06 | |
| | 9/01/72 | 0.02 | |
| | 9/02/72 | 0.02 | |
| FC-E | 8/28/72 | 10.9 | 78.7 |
| | 8/29/72 | 125.0 | |
| | 8/30/72 | 162.0 | |
| | 8/31/72 | 82.5 | |
| | 9/01/72 | 10.0 | |
| | 9/02/72 | 82.5 | |
| $FC-D_1-1$ | | No samples taken | |
| $FC-D_1-2$ | | No samples taken | |
| $FC-D_2$ | 8/28/72 | 0.53 | 2.13 |
| | 8/29/72 | 2.00 | |
| | 8/30/72 | 4.50 | |
| | 8/31/72 | 3.00 | |
| | 9/01/72 | 0.25 | |
| | 9/02/72 | 2.50 | |
| $FC-D_3$ | 8/28/72 | 0.32 | 0.44 |
| | 8/29/72 | 0.58 | |
| | 8/30/72 | 0.45 | |
| | 8/31/72 | 0.45 | |
| | 9/01/72 | 0.56 | |
| | 9/02/72 | 0.29 | |

TABLE 5

Total Nitrogen Levels at Flat Creek Sampling Stations

| Station | Date | Total Nitrogen (mg/l) | Average Total Nitrogen (mg/l) |
|---|---|---|---|
| FC-U | 8/28/72 | < 0.1 | < 0.14 |
| | 8/29/72 | 0.2 | |
| | 8/30/72 | 0.25 | |
| | 8/31/72 | 0.04 | |
| | 9/01/72 | 0.02 | |
| | 9/02/72 | 0.26 | |
| FC-E | 8/28/72 | 13.4 | 161.5 |
| | 8/29/72 | 231 | |
| | 8/30/72 | 253 | |
| | 8/31/72 | 200 | |
| | 9/01/72 | 8 | |
| | 9/02/72 | 264 | |
| $FC-D_1-1$ | | No samples taken | |
| $FC-D_1-2$ | | No samples taken | |
| $FC-D_2$ | 8/28/72 | 1.12 | |
| | 8/29/72 | 5.10 | |
| | 8/30/72 | 7.36 | |
| | 8/31/72 | 5.91 | |
| | 9/01/72 | 0.44 | |
| | 9/02/72 | 8.02 | |
| $FC-D_3$ | 8/28/72 | 0.87 | 0.99 |
| | 8/29/72 | 0.78 | |
| | 8/30/72 | 0.73 | |
| | 8/31/72 | 1.08 | |
| | 9/01/72 | 1.32 | |
| | 9/02/72 | 1.20 | |

A decrease in algal covering on the bottom, and consequent reduction in the actual amount of substratum sampled, may also account for part of the reduction in the number of organisms per sq. ft. The reason for the increase in the number of midges per sq. ft. from the previous upstream station is not known.

The only evident detrimental effect of the effluent was the smothering by the congealed whey at sampling station FC-$D_1$-1. Although congealed whey was observed downstream as far as sampling station FC-$D_3$, no blanketing effect was evident as the congealed whey was isolated to small masses.

Large reductions in dissolved oxygen concentrations, a possible detrimental effect of whey discharges into water, were not realized. The dissolved oxygen level was reduced from an average of 8.0 mg/l at the upstream control station to an average of 5.7 mg/l at sampling station FC-$D_2$, a reduction insufficient to produce gross detrimental effects in the benthic community. At sampling station FC-$D_3$, the dissolved oxygen concentration averaged 7.3 mg/l.

Initial examination of the Salt River benthic samples evidenced pollution sensitive mayflies, caddis flies, and stoneflies, both upstream and downstream of the confluence of Salt River and Flat Creek. As no detrimental effects of the effluent on the benthic community were observed at the farthest downstream station on Flat Creek (FC-$D_3$), further processing of the benthic samples from Salt River to show detrimental effects on the benthic community below the confluence was deemed unnecessary.

TABLE 6

Dissolved Oxygen Concentrations at Flat Creek Sampling Stations

| Station | Date | Dissolved Oxygen Concentrations (mg/l) | Average Dissolved Oxygen Concentrations (mg/l) |
|---|---|---|---|
| FC-U | 8/28/72 | 8.3 | 8.0 |
| | 8/29/72 | 7.6 | |
| | 8/30/72 | 8.0 | |
| | 8/31/72 | 8.1 | |
| | 9/01/72 | 8.2 | |
| | 9/02/72 | 7.9 | |
| FC-E | 8/28/72 | 3.6 | 2.7 |
| | 8/29/72 | 1.7 | |
| | 8/30/72 | 1.5 | |
| | 8/31/72 | 2.9 | |
| | 9/01/72 | 4.9 | |
| | 9/02/72 | 1.4 | |
| $FC-D_1-1$ | | No samples collected | |
| $FC-D_1-2$ | | No samples collected | |
| $FC-D_2$ | 8/28/72 | 6.0 | 5.7 |
| | 8/29/72 | 5.4 | |
| | 8/30/72 | 5.4 | |
| | 8/31/72 | 6.1 | |
| | 9/01/72 | 5.7 | |
| | 9/02/72 | 5.4 | |
| $FC-D_3$ | 8/28/72 | 7.5 | 7.3 |
| | 8/29/72 | 7.4 | |
| | 8/30/72 | 8.2 | |
| | 8/31/72 | 7.7 | |
| | 9/01/72 | 5.2 | |
| | 9/02/72 | 7.5 | |

## SUMMARY

1. The Star Valley Dairy, Thayne, Wyoming, discharges whey and raw sewage into Flat Creek, which then flows into the Salt River.

2. On October 29-30, 1972, members of the Region VIII Environmental Protection Agency conducted a benthic organism survey on the Flat Creek and the Salt River to determine possible effects of the Star Valley Dairy effluent on the benthic invertebrate community.

3. The effluent had a detrimental effect on the benthic community in Flat Creek due to a smothering blanket of congealed whey desposited on the bottom. The blanketing occurred only on the effluent side of the stream and extended for approximately 30 to 40 yards downstream from the discharge point.

4. Although masses of congealed whey were observed 300 yards downstream from the discharge, no blanketing of the bottom occurred. The three major constituents of the benthic population--mayflies, blackflies, and midges--increased greatly from the upstream control station due to the enrichment effect of the sewage portion of the effluent.

5. At the last downstream station on Flat Creek, the quantity of mayflies and blackflies, although greatly reduced from the previous upstream station, still exceeded the control station samples.

6. No detrimental effect of the effluent was observed at the farthest downstream sampling station on Flat Creek.

7. Dissolved oxygen concentrations were not greatly reduced in Flat Creek due to relatively high dissolved oxygen levels of the effluent.

8. Initial examination of the Salt River benthic samples showed pollution sensitive mayflies, caddis flies, and stoneflies evident both upstream and downstream of the confluence of Flat Creek and the Salt River. As no detrimental effects of the effluent on the benthic community were observed at the farthest downstream station on Flat Creek ($FC\text{-}D_3$), further processing of the benthic samples from the Salt River was deemed unnecessary.